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## THE ORIGIN OF YELLOW FEVER.

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YELLOW FEVER has been the subject of some of the most violent controversial storms that have ever ruffled the surface of medicine. Whether the fever was contagious or non-contagious, whether it was imported or bred on the spot, whether it was a peculiar kind of specific fever, or only a severe form of malarial fever,—these are some of the questions that have been hotly debated, and nowhere more hotly than among the medical men of Philadelphia, in the life-time of the great Dr. Benjamin Rush. It is now possible to look at these controversies in the perspective of history, and fortunately it is possible for most of the Atlantic cities of the United States so to regard the disease itself. The discussions as to its nature and origin and its mode of conveyance are no longer in the acute stage of violent and irreconcilable antagonisms. The air is cleared, and the chaos has fallen into something like order; and if there are still various hypotheses of the origin of the fever, there is almost complete agreement as to all its associated circumstances, or its natural-history characters among the species of disease. No single work has contributed so much to the modern disentanglement as the two volumes of elaborate inquiry and dispassionate statement brought out by Dr. La Roche, of Philadelphia, in 1855, a work that reflects the highest credit on American scholarship and research.

But, although Dr. La Roche has carefully gone over the whole ground, and sifted and scrutinized everything that has turned up, through sixteen hundred closely printed pages, it appears to my humble judgment that he has somehow never caught the sparkle of the gem that he was seeking for. The secret of yellow fever, it seems to me, is contained in the almost forgotten essays of Audouard. La Roche quotes the title of these among the innumerable other books and pamphlets; but I

find nowhere in his pages any evidence that he had mastered the facts of Audouard's argument, or duly weighed its conclusions. Dr. Audouard failed to secure the *imprimatur* of the French Academy of Sciences for his various essays on yellow fever, and the neglect of them is one more illustration of the fact that the world is too busy to form its opinion at first hand on a question. My attention to Dr. Audouard's theory of yellow fever was first attracted by finding it described in Prof. Hirsch's well-known treatise on Geographical and Historical Pathology, which was then coming out in English, as *eine der abenteuerlichsten Hypothesen*. Stimulated rather than deterred by this damaging epithet, I procured the book from the library of the Royal Medico-Chirurgical Society of London. The library owed its copy to the mindfulness of the author himself, according to an autograph letter pasted within the cover, and bearing date, April 11, 1825.

Dr. Audouard's letter, a folded quarto sheet, now yellow with age, is a well-written appeal to academical medicine in England to give its best attention to the very serious facts that he had discovered when inquiring officially into two of the Spanish epidemics of yellow fever in 1821 and 1823. At Barcelona and Passages respectively, in these years, it had struck him with peculiar force that the fever had issued from the holds of ships that had been employed in carrying negro slaves from the west coast of Africa to Havana, and had returned to Spain with West Indian produce.

"Cette conformité d'origine dans deux cas différens, me porta a faire des recherches à la faveur desquelles j'ai trouvé le moyen d'expliquer tout ce qui, jusqu'à présent, avait été obscur et inexplicable. . . Ces memoires contiennent des idées nouvelles auxquelles je n'en doute pas, vous ne refuserez pas votre attention; et si elles vous paraissent propres à seconder les vues de votre gouvernement relativement à la traité des noirs, vous vous en expliquerez franchement afin de vous montré favorable à l'humanité d'une double maniere, savoir; en travaillant à abolir l'esclavage des noirs, et en preservant la race blanche de la fièvre jaune qui est le resultat de ce trafic."

Like every one who trusts to ideas making their way by their inherent force, Dr. Audouard was much too sanguine when he wrote: "Je n'en doute pas, vous ne refuserez pas votre attention." It soon became apparent, as I proceeded to glean the "idées nouvelles," that not one officer or fellow of the society in all those years had taken the trouble to cut the leaves. The fact

was, the terrible yellow-fever epidemics that ravaged the Spanish ports and threatened the rest of Europe in the beginning of the century were already over, and Europe was all the more ready to forget its danger from the Western pestilence in its preoccupation with a new enemy, the cholera. But the interest in yellow fever is still real for the Western Hemisphere, and it seems to me to be desirable for both theory and practice that Dr. Audouard's facts and reasoning should receive full attention.

If we take a sketch-map of the world and color on it the places where yellow fever has been most prevalent at one time or another, we shall find that they group themselves in a very significant manner. The whole continent of Asia, the cradle of so many great pestilences, takes no share; Africa does not concern us, except for two or three small spots on the western coast; no part of Europe has to be colored in, except certain ports of Spain and Portugal. Our spots of color are nearly all on the American side of the Atlantic, and they are but minute points on the coast. Yellow fever is a pestilence of certain shipping-places, and particularly of their harbors, wharves, and sailors' quarters. Now and then it has penetrated beyond the sea-port or the banks of a navigable river, as in the great epidemics in Spain in the beginning of the century; but the circumstances were those of exceptional virulence of the poison and exceptional panic among the people, and they serve rather to show how remarkably uniform the behavior of yellow fever has been, on the whole. While Barbadoes and Antigua have a healthy climate, Bridgetown and English Harbor have been notorious for the epidemic of yellow fever. It is not all Cuba, but Havana; not all Hayti, but Port au Prince; not Martinique, but Port Royal; not South Carolina, but Charleston; and not Pennsylvania, but Philadelphia.

Putting together these singular facts of geographical distribution, and adding what we know of history, we are led to the conclusion that the ports of yellow fever are mostly the old ports of debarkation in the slave-trade, the first authentic epidemics having occurred shortly after the first arrivals of slave-ships in the West Indies. The pestilence first showed itself at Bridgetown in 1647, twenty years after the English began to plant there; and we know from an authentic document that in 1650 there were at that place flourishing sugar-plantations well stocked with negroes. The "new disease" took every one by surprise. It

was "an absolute plague, very infectious and destroying," says Mr. Vines, writing to Governor Winthrop, of New England, "inso-much that in our parish there were buried twenty in a week, and many weeks together fifteen or sixteen." Mr. Vines thought it was a punishment for the sins of the people, that it was "the Lord's heavy hand in wrath"; and Captain Ligon, who came out from England while it was raging, believed that it was somehow connected with the arrival of ships. The "Pere Dutertre" says it was "*une peste jusqu' alors inconnue dans les isles*," and that it carried off one-third of the inhabitants of St. Kitts in eighteen months. During the two centuries following, it has become endemic at many ports, and these are the places at which slave-ships have either discharged their negroes, or gone in ballast or with merchandise on the round voyage. The one considerable exception is the Peruvian coast, where yellow fever appeared first in 1853. I am prepared to deal with that exception and with others, if space permitted; but it must suffice to say here that the people of Callao, for some reason, blamed the arrival of filthy ship-loads of Chinese coolies, who had suffered terribly from dysentery; that the Chinese in Lima are said to be almost as much protected against yellow fever as the negroes on the Atlantic side; and that the Chinese coolie trade, from 1847 to 1856, was carried on by "ships badly equipped and overcrowded, and on their voyages they reproduced all the horrors of the 'middle passage' in the old African slave-trade."—("Encyclopædia Britannica," Article "Coolie.")

If the association of yellow fever with the ports of debarkation of the slave-trade were absolutely invariable, I should regard it as a suspiciously neat result. A certain small margin of exception is a healthy sign in any hypothesis. The broadly impressive fact remains that yellow fever has been, both in place and in time, a close attendant on the slave-trade; that it has followed its rise and its decline at a given place, although it has survived longer at some points than at others; and that its exacerbations have coincided with the most lawless period of the traffic. What is the meaning of this association between the importation of slaves and yellow fever at the ports of debarkation, between the horrors of the "middle passage" and the after horrors of the landing-place? It is no other than the ancient association between filth and fever; but there is something quite peculiar both in the filth and in the fever.

In the first place, we have to observe that negroes on board slave-ships do not appear to have suffered from yellow fever. Whether any part of the enormous mortality among the white crews of slavers was due to yellow fever, we never shall know. These things were kept conveniently dark, and it took all of Clarkson's persistence to find out that there was any excessive mortality at all. What took place on board slave-ships on the "middle passage" is now as far beyond the reach of exact research as the slave-trade itself is beyond the possibility of revival. But we have several interesting experiences, or undesigned experiments, of the contact of white men with a shipful of negroes, which happened under circumstances that could compromise no one, and have been authentically entered on the medical record. One of these occurred to the late Dr. James Copland, author of the "Dictionary of Practical Medicine," and it sufficed, along with observations made subsequently, to start Dr. Copland's mind in the train of reasoning that Audouard was to follow independently a few years later. He says:

"A small vessel, in which I was a passenger, was anchored, in May, 1817, a short distance from Sierra Leone; and the ship's boat, with four of the crew, was bringing me on board, when, a tornado suddenly overtaking us, we took shelter on board a ship recently brought into the harbor full of slaves, and near which we were at the time. The men belonging to the boat took shelter down between decks. I remained under a small poop on the quarter-deck. All these men in two or three days were seized with this distemper [yellow fever], the vessel having just put to sea, and I escaped. The sick men were constantly kept on deck, free ventilation was enforced, and every possible precaution used, and no more were attacked. The organization of the negro, and the more extensive functions of the skin of this race as an excreting organ, give rise to the most offensive and foul state of the atmosphere when numbers of this race are confined in a limited space, and particularly in a humid and warm atmosphere. Indeed, nothing can be imagined more nauseous and depressing than the respiration of the air so contaminated; and it may further be admitted that it so affects the organic nervous system and the blood as to develop this pestilence. . . . The above fact, these considerations, and various occurrences or outbreaks of this distemper after communications with slave-ships that have come to my knowledge, induce me to attach some importance to this source of the evil, and to suggest that some endeavor should be made to ascertain the amount of credit it may deserve. . . . If this opinion as to the probable origin of the infectious poison be not admitted, there is certainly none other deserving greater confidence, and we are left entirely in the dark as to the earliest origination of the mischief."

Dr. Copland's suggestion of direct contact with a crowd of negroes goes only a little way, as he was himself aware; it

needed the somewhat different observations of Audouard (which Copland would seem not to have heard of even in 1858) to furnish a theory of yellow fever that would be wide enough for all the facts. But, before I come to that subject, I shall give two other instances, collected from the naval medical history of the period, to set beside Copland's. The *Regalia*, British transport, was employed in 1815 in carrying black recruits from the Guinea coast to the West Indies. When on the coast the health of the ship had been excellent, but during the voyage much sickness, chiefly of the dysenteric kind, occurred among the blacks. Thereupon yellow fever broke out with great malignancy, attacking all on board except the blacks, who, from first to last, were exempt from the specific fever. The case of the *Regalia* is well known, and it used to be quoted as showing that yellow fever was only a form of malarial fever, the malarial miasm in this case having come from a quantity of green wood that had been shipped at Boa Vista. The green-wood theory was always improbable, and the modern disentanglement of yellow fever from malarial remittents deprives it of whatever small probability it ever had. The other case, which I take from Gillespie, is equally suggestive. The French frigate *La Pique* fell into the hands of the English when Martinique was taken, in 1794, and in November, 1795, was sent with a prize crew to Barbadoes. On the voyage they took two hundred negroes from a French vessel that was in danger of foundering. The negroes were confined in the hold, and in a short time yellow fever appeared among the *La Pique's* crew, and proved fatal to one hundred and fifty of them, although it did not attack the negroes at all. "Such a mixture of men, strangers to each other," says Gillespie, "has been often found to occasion sickness in ships; and, together with other causes, fatally operated here before the arrival of the ship at Barbadoes. . . . This is a melancholy instance of the generation of a fatal epidemic on board ship at a time when the inhabitants of Barbadoes and the crews of the other ships in company remained free from any such disease."

The immunity of the pure-blood negro from yellow fever has often been remarked, and it comes so near to being a universal truth that its significance cannot be questioned. The full meaning of it will appear from the fact that, at Vera Cruz in 1866, when the soldiers of the French Expedition were dying of yellow

fever by hundreds there was not even a single case of the sickness in the regiment of five hundred black troops that the French had recruited in the Soudan and Nubia. The immunity from yellow fever that the negro of unmixed blood enjoys is, to my thinking, the most remarkable fact in pathology. Here is a race that, in the Western Hemisphere, lives in the very haunts of yellow fever, and yet passes unscathed through an epidemic, while hundreds of whites are dying around them. "In the natives of Africa," says Doughty, a Jamaica physician of the beginning of the century, "the constitution appeared to me as secure against yellow fever as a person who has had the small-pox is against its recurrence." He might have said, as secure as if they had had yellow fever itself.

The explanation of this unique fact is supplied by the theory of Audouard, although that author gave hardly any heed to negro immunity. The poison of yellow fever, said Audouard, comes in the last resort from the discharge of the sick negro; it is generated by the fermentation or putrefaction of the dysenteric and other filth of slave-ships. The scourings of slave-ships had been thrown out at the ports of debarkation to mix with the mud of creeks, careenages, and mangrove swamps, to fluctuate to and fro with the sluggish ebb and flow of the tide, to ferment under a tropical sun, and to taint the soil of the beach, the foundations of houses, and the water-conduits. All this poisonous filth has accumulated most in the very quarters where negroes live, and it is in those amphibious quarters of towns in the West Indies and along the shores of the Gulf of Mexico that yellow fever lingers, and every now and then rises to an epidemic. But it hardly touches the negro; it spares him in proportion to the purity of his racial characters. As the noxious miasmata that give rise to yellow fever have come from the negro body, they cannot poison the negro again. Yellow fever is what Sir Gilbert Blane calls a vicarious infection; it is vicarious to the horrors of the "middle passage." Dr. Audouard's theory thus acquires a certain ethical probability.

The circumstances at the small port in Biscay that first led Dr. Audouard to this conclusion may be taken as fairly typical of the conditions of the origin of yellow fever, not only at other Spanish ports, but also in the Western Hemisphere, and now and then on the west coast of Africa. It is for the most part not simply an affair of white men being in the same ship with



negroes, but of the filth of slave-ships getting into the harbor mud, and the soil where such ships had lain, and through its fermentation becoming a more or less enduring and transportable specific infection.

On the 2d of August, 1823, a brigantine owned in Bayonne, called the *Donostiarra*, arrived at Passages, a small fishing-place near San Sebastian, to dispose of the remainder of a cargo of West Indian produce shipped at Havana. For two or three weeks the *Donostiarra* was an emporium for the sale of sugar, tobacco, coffee, honey, bees-wax, etc. She lay on the beach, right before the houses and shops of Passages, being approachable on foot at low tide. When the cargo was all disposed of, some necessary repairs on the hull were begun by the Passages carpenters on the 18th of August. Part of the planking of her bottom had to be renewed, and a piece of new keel put in; and the workmen had hardly begun when they began to fall ill, one after another; and they attributed their illness to a sickening smell that came from the foul bilges of the vessel as they opened them up. It became difficult to get other workmen to take their places, and extra pay had to be offered. Meanwhile two or three of the carpenters who had been first at work died, as well as a custom-house officer, and one or two other persons who had been about the ship. The sickness was one that the people of Passages, as well as the two doctors practicing there, had never seen before. It was evidently spreading in the place, and as a French army lay at San Sebastian, four or five miles away, the Government sent a commission of inquiry. One of the commissioners was Dr. Audouard, who had been sent on a similar mission to Barcelona two years before. The disease proved to be yellow fever, and it attacked more than a hundred persons, chiefly in the houses along the beach, causing forty deaths. The *Donostiarra* had left Havana in the beginning of June, with a clean bill of health. One of the crew died about the tenth day out, probably from the effects of drinking; and the remaining fourteen of a crew, with five passengers, arrived at Corunna in good health after a voyage of thirty-five days; and all remained well for ten days longer, while the vessel was in quarantine.

It was thus difficult to trace the epidemic at Passages to cases of yellow fever on board. The clue that Dr. Audouard laid hold of was, that this innocent-looking brigantine, supplying tobacco, coffee, sugar, and honey to the Biscayan fishermen,

was engaged in the contraband slave-trade; she had taken out negroes from the west coast of Africa to Havana early in the year, and was now quietly completing her usual round voyage. This discovery led him to inquire again into the facts of the disastrous epidemic at Barcelona two years before, in which five thousand persons had died. It had been traced by common consent to two ships in particular,—the *Grand Turc* and the *St. Joseph*,—which had to be scuttled. The fresh inquiry proved that both of them were slavers, and that the dysenteric sickness and mortality among the negroes on board one of them during the trip immediately preceding had been exceptionally severe. These singular coincidences set Dr. Audouard thinking and inquiring. He calculated that sixty or seventy ships were making the same kind of round voyages as the *Donostiarra*, the *Grand Turc*, and the *St. Joseph*; and he concluded that the same circumstances that he found at Passages and Barcelona must have occurred repeatedly at Cadiz, Seville, Malaga, Tortosa, the Balearic Isles, and other Spanish ports where yellow fever had been epidemic again and again, especially in those early years of the century, when the doom of the legitimate slave-trade had been pronounced, and the traffic was passing into contraband hands. He pointed out, also, on the authority of Moreau de Jonnés, that whereas there had been fifty-seven epidemics in the American ports, from Newport down to New Orleans, during the sixteen years preceding the abolition of the traffic in 1808, there had been only seven in the sixteen years following that event, and even these he thought might be due to the trade being carried on by stealth. Dr. Audouard lived long enough to see a still greater decrease of yellow fever on the Atlantic sea-board of the United States, and to see the fever establish itself as a new disease at Rio and other Brazilian ports in 1849, the slave-trade having been diverted to Brazil, when all other countries except the Spanish Antilles had given it up.

In seeking to explain all the outbreaks of yellow fever, it is necessary to keep in mind that it has certain great endemic centers, such as Havana, at which the peculiar kind of filth that causes it has been discharged in material quantities, penetrating the mud of harbors and the soil of low-lying quarters of towns, where it has fermented and its virus multiplied, and has so become a long-enduring—I do not say permanent—source of poisonous miasmata. The poison has been carried from these

harbors over and over again in the bilges of wooden ships; it has entered through their opening seams, and has arisen in noxious vapors to infect the crew; and, as we have seen in the instances that occurred in Spain, it has even delayed its destructive power until it has crossed the ocean and mixed with the shore mud of a distant port. It becomes even more virulent than amidst its primitive mud, when it is sucked up through the planking of a ship's bottom, to ferment in airless recesses of her hold. In this way wooden ships, that have been lying up in West Indian and Brazilian ports, have become sources of danger, even in recent times, to New York, St. Nazaire, and Swansea, and may be sources of danger for some time to come. They are dangerous, because they carry a material quantity of the specifically poisonous filth in their bilges; and it is noteworthy, says Blane, that the fevers arising from this cause "are found sometimes to be contagious and sometimes not, according to the intensity and nature of the effluvia."

. I shall mention briefly the most terrible historical instance of ships charging themselves with the poisonous mud of a slave-port. On the capture of Port au Prince, Hayti, June 4, 1794, about forty merchantmen were found in the harbor, most of them large vessels, laden with cargoes of coffee, sugar, cotton, and indigo, which had been lying stowed in them from one to three years. During all that time, many of them had never had their holds opened, owing to the suspension of labor and business during the revolution. English prize crews were put on board to navigate them to Port Royal and other British West Indian ports, and they had hardly put to sea when yellow fever attacked them with unheard-of suddenness and virulence. One of the prizes was picked up by a Guinea man, and every man on board was found to be dead. Even the negroes who were put to clean them out took the fever and died.

Of the prevalence of yellow fever at Havana I need not speak, nor is it necessary to point out that for two centuries slavers that entered that spacious bay might have been counted by the hundred in almost any year. The bay of Havana is land-locked on every side by high hills; it opens to the sea by a single narrow channel; there are several shoals or mud-banks in its recesses, and the tide does not rise and fall more than three or four feet. The experience and reasonings of men who held no theories of

disease taught them that there was something wrong with the sea-water at Havana. La Roche says :

“The water of the bay is often very offensive ; all vessels pump their bilge-water into it, and it cannot be changed. It is so full of decomposing materials that the British naval service has a standing order not to use the water for any purpose on board. The United States ship-of-war *Macedonian* arrived from Boston at Havana, April 28, 1822, with a healthy crew. There was no yellow fever in Havana at the time. Water was let into the hold at intervals between the 28th of April and the 7th of May ; when the captain, hearing of the standing rule in the English navy, discontinued the practice. A few days after being let in, the water in the bilges was found to be very filthy and offensive, so much so that, when it was being pumped out, all of the crew except the men required for the pumps were sent either to a distance in the boats or into the tops. The chain-cable, when hove in, was found covered with an offensive gelatinous substance. The first case of yellow fever on board occurred on the 8th of May, and the patient died on the 11th ; another death occurred on the 19th, and then the disease spread rapidly and fatally among the crew and officers ; and, although the vessel put to sea, she continued to be a source of infection for several months, one hundred and one out of a company of three hundred and seventy-six dying of yellow fever. In this case the putrid sea-water of Havana harbor was the source of yellow fever ; and such putridity can have had no other origin than the accumulated filth of hundreds of slave-ships discharged into it for two centuries.”

Space does not permit me to give all the evidence that I have put together of this kind. The writings of Lind, Trotter, and Gillespie furnish graphic descriptions of the careenages of Port Royal, in Martinique ; of English Harbor, in Antigua ; of Bridgetown, in Barbadoes ; of Port au Prince, in Hayti, and the like. There is always the sweltering mud, the noxious exhalations, the air kept stagnant by the inclosure of hills, and the English sailors dying on board the ships-of-war like rotten sheep. Speaking of yellow fever at Bridgetown, in 1694, Lind says : “Captain Thomas Sherman, of H. M. S. *Tiger*, in the two years that he lay there, buried out of her six hundred men, as he told me, though his complement was but two hundred.” Again, the same writer says of English Harbor, in Antigua : “The stagnated air becomes so unwholesome that men, after being there a few days, are suddenly seized with violent vomitings, headaches, delirium, etc., and in two or three days more the dissolved mass of blood issues from every pore. In such places the water of the sea itself would probably become putrid, and destructive to the very fish, were it not kept in motion by a gentle flux and reflux, which may be perceived every day.” Once

more, Gillespie says of the yellow fever at Port Royal in 1794: "The disease did not make any rapid progress until the ship had remained some weeks in the bay of Trois Islets, where the sultry calms that reigned in August and continued all the hurricane months, the vitiated state of the internal air of the ship, from dampness, foul ballast, the steam of bilge-water, and the like, promoted the spreading of the disease. . . . The contagion, which had been remarked to be active on board, did not seem to be powerful in exciting the disease on shore; few, if any, persons were infected by it on land."

But it wants a great deal more than the natural exhalations of even a tropical harbor, or the mangrove swamps around it, to produce yellow fever. Something has been added to the natural mud of some of those harbors, and that something was the filth pumped out or thrown overboard from every slaver that had arrived during a period of nearly two hundred years. The cleaning out of a slaver after a run from Africa was no ordinary business; white men could not be got to do it, probably because the effluvia did not agree with their health, and the blackest of Kroomen from Sierra Leone were set to the task. But the risk of the whites was by no means confined to the actual cleaning out of the ship's hold. The filth was not by any means got rid of when it was thrown into the water of a land-locked and almost tideless harbor; it entered into the composition of the mud, and even tainted the sea-water itself. The noxious exhalations, or miasmata, which have at all times and in every place been assigned as the cause of yellow fever, are not the natural exhalations of the soil or water, nor can they arise from soil and water fouled by ordinary sewage. The filth that breeds it is the filth of another race, and, furthermore, it is the peculiar filth of the "middle passage."

How long that taint can linger in a harbor's mud, or in the alluvial foundations of houses along the shore, it would be hazardous to pronounce. Certain it is, that the soil of Philadelphia and the mud of the Delaware are long since clear of it, nor is it likely that it still exists to any considerable extent in the soil of Charleston; and we may assume that the Gulf and West Indian ports would not have retained it for so many years after they ceased to receive its annual accretions, but for the sluggishness of their waters. The plunging tides of the Atlantic have almost washed away the traces of a cruel traffic that once

visited every American port from Cape Cod to the Cape of Florida, a traffic that brought in its train the far-reaching Nemesis that wrong-doing never fails to bring. It may take long to remove the last traces of slave-ships in the bay of Havana, and efface the memory of wrongs that even the deep water of the sea refuses to hide; but the ministers of Nature are silently working to preserve both the physical and the moral order, and even along the Spanish main there is something to hope from

“The moving waters at their priest-like task  
Of pure ablution round earth’s human shores.”

C. CREIGHTON.